

Globodera hypolysi n. sp.,
a Mugwort Cyst Nematode from Japan

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Spherical cysts of *Globodera* nonparasitic on Irish potato and tobacco found in the potato growing area in 1976 at Shimabara, Nagasaki, Japan, were described as *Globodera hypolysi* n. sp. Inoculation tests have proved that mugwort, *Artemisia princeps* PAMP., is an only host of this species. This species differs from the related species, *G. artemisiae* or *G. achilleae*, which has a common host of mugwort or Compositae, in the distance from the anus to the fenestra in the cyst and female, length of the second-stage larvae, and the anterior face of the larval stylet knobs. *Jpn. J. Nematol.* **12**:41-46 (1983)

OGAWA and others reported for the first time in 1976 the existence of several spherical cysts considered to belong to the genus *Globodera* in a potato-growing area in Shimabara Peninsula, Nagasaki Prefecture⁹. These cysts appeared different from those of *Globodera rostochiensis* (WOLLENWEBER, 1923) in morphological characteristics as well as host range. In 1979, the same cyst nematode was detected in Azuma-cho, Shimabara Peninsula, and inoculation tests proved that this species propagated only on mugwort, *Artemisia princeps* PAMP., and not on potato or sow thistle. Although *Globodera artemisia* (EROSHENKO et KASACHENKO, 1972) has been reported to parasitize wormwood, *Artemisia rubripes* NAKAI³), morphological studies reveal differences between two species, and this is described as a new species under the name of *Globodera hypolysi*.

MATERIALS AND HOST PLANT TESTS

In March 1980, cysts were collected from Azuma-cho, Nagasaki Prefecture, and inoculation of potato, sow-thistle (*Sonchus oleranceus* L.) and mugwort plants (*Artemisia princeps* PAMP.) with the cysts was conducted as follows: roots of sow thistle and mugwort plants collected from the fields were thoroughly washed and transplanted, while potato tubers (cv. Dejima) were planted in pots (1/5,000 a). Each pot was inoculated (3 replications) with 100 cysts within a 100-mesh net and grown in a greenhouse.

After six months, propagation of the cysts was examined. A large number of males, females, cysts and 2nd stage larvae were detected only in the mugwort pots indicating possible propagation of this species.

Specimens obtained from these materials were killed by moderate heating, fixed in TAF, stained with aniline blue lactophenol and mounted in glycerol.

GLOBODERA HYPOLYSI n. sp.

Description and Measurements

Females. Paratypes: n=85, L(excluding neck)=320-540(mean: 415.4) μ m, width=210-470(317.6) μ m, L/W ratio=1.0-1.7(1.33), neck length=70-210(96.7) μ m, stylet(n=24)=22-26(24.4) μ m, opening of dorsal esophageal gland duct from stylet base(=o. d. e., n=20)=2-5(4.3) μ m.

Holotype: L=400 μ m, width=285 μ m, L/W ratio=1.4, neck length=90 μ m, stylet=25 μ m,

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o.d.e.=4 μ m.

Body pearly white, ovate to subspherical in shape, with elongated, protruding neck, and rounded posteriorly. Cuticle thick, outer layer rugose in posterior portion. Head set off from neck. Stylet strong with well-developed knobs sloping posteriorly. Excretory pore at base of neck and 99-178 (130.7) μ m from anterior end. Vulva shaped as drawn (Fig. 1, H), measuring 12-20 (16.5) μ m on an axis at 90 degrees to vulval slit and 12-18 (14.4) μ m on axis with vulval slit, which is 4-6 (5.1) μ m in length. Anus small but distinct, located 32-57 (47.5) μ m from nearest edge of vulva and opposite the long axis of vulval slit. Anal area encircled by cuticular rings.

Cysts. Paratypes: n=50, L(excluding neck)=370-600 (475.6) μ m, width=320-620 (448.1) μ m, L/W ratio=0.87-1.43 (1.15), neck length (n=28)=70-190 (96.5) μ m, fenestral length (n=30)=16-27 (20.9) μ m, fenestral width (n=30)=15-25 (18.7) μ m, distance from anus to nearest edge of fenestra (n=30)=25-80 (43.6) μ m, Granek's ratio=1.2-3.5 (2.1).

Cysts light to dark brown in color, ovate to sub-spherical in shape, with protruding neck. Circumfenestrate generally visible. Fenestra much larger than the small but distinct vulva. The "bullae-like structures" formed compact circles around the fenestra. Underbridge invisible. Anal area encircled by cuticular rings. Cyst wall pattern basically as in female but often more prominent, and especially near midbody, tends to form wavy lines running latitudinally around body. Punctuation generally present but variable in intensity and arrangement.

Males. Paratypes: n=50, L=715-1,200 (982.8) μ m, width at excretory pore=20-26 (23.3) μ m, a=35.2-53.2 (42.2), anterior end to junction of esophagus and intestine (n=21)=119-153 (132.5) μ m, b=6.3-8.0 (7.3), anterior end to center of median bulb=75-98 (86.4) μ m, bm(=total body length/distance from anterior end to valve plates in median bulb)=9.1-13.8 (11.4), anterior end to end of esophageal glands=154-238 (198.5) μ m, b'=3.7-6.4 (5.0), anterior end to excretory pore=104-169 (145.9) μ m, X(=distance excretory pore from anterior end \times 100/total body length)=12.1-17.8 (14.3), stylet=24-30 (27.4) μ m, o.d.e.=3-5 (3.6) μ m, o(=o.d.e. \times 100/stylet length)=10.7-16.0 (13.5), testis (n=30)=350-590 (464) μ m, T=44.0-57.8 (49.9), spicules (n=25)=24-33 (29.2) μ m, gubernaculum (n=10)=6-8 (7.2) μ m.

Allotype: L=863 μ m, width at excretory pore=24 μ m, a=36.0, b=6.9, c=172.6, head annules=7, head height=5 μ m, head width=11 μ m, stylet=26 μ m, o.d.e.=4 μ m, anterior end to junction of esophagus and intestine=126 μ m, anterior end to end of esophageal gland=185 μ m, anterior end to excretory pore=135 μ m, testis=505 μ m, spicules=32 μ m, gubernaculum=7 μ m.

Body slender, vermiform with short bluntly rounded tail of variable shape. Body strongly curved giving C or S shape by heat relaxation with posterior part twisted 90 to 180 degrees along longitudinal axis. Cuticle with regular annulations, four incisures in lateral field terminating on tail. Head slightly offset, hemispherical, with 6 to 7 annules in most specimens and measuring 10-12 (10.9) μ m wide at its base and 5-6 (5.2) μ m high. Cephalic framework heavily sclerotized. Anterior and posterior cephalids at second to third and 6th to 8th body annules, respectively. Stylet well developed, with rounded basal knobs. Dorsal esophageal gland orifice 3-5 (3.6) μ m behind the stylet knobs. Median esophageal bulb ellipsoid, with its center 75-98 (86.4) μ m from anterior end. Nerve ring broad and encircling the esophagus half-way between median bulb and intestine; esophageal-intestinal valve small and inconspicuous. Junction of esophagus and intestine near the level of excretory pore, at about 15% body length from head. Hemizonid two annules long, situated 4-5 annules (n=20) anterior to excretory pore, hemizonion at 7-11 annules (n=4) posterior to excretory pore. Testis single, about 50% of body length. Spicules slightly arcuate, with tips rounded, unnotched.

Second stage larvae. Paratypes: n=50, L=410-510 (460.6) μ m, width at excretory pore=16-18 (17.2) μ m, a=24.4-31.4 (26.8), anterior end to junction of esophagus and intestine (n=17)=92-102 (95.6) μ m, b=4.3-5.2 (4.8), anterior end to end of esophageal glands (n=40)=147-193 (172.4) μ m, b'=2.3-3.1 (2.7), anterior end to excretory pore=91-104 (98.0) μ m, X=20.0-24.2 (21.3), tail=42-61 (47.2) μ m, c=7.4-11.0 (9.8), body width at anus=11-13 (12.1) μ m, c'=3.2-5.1 (3.9), hyaline tail

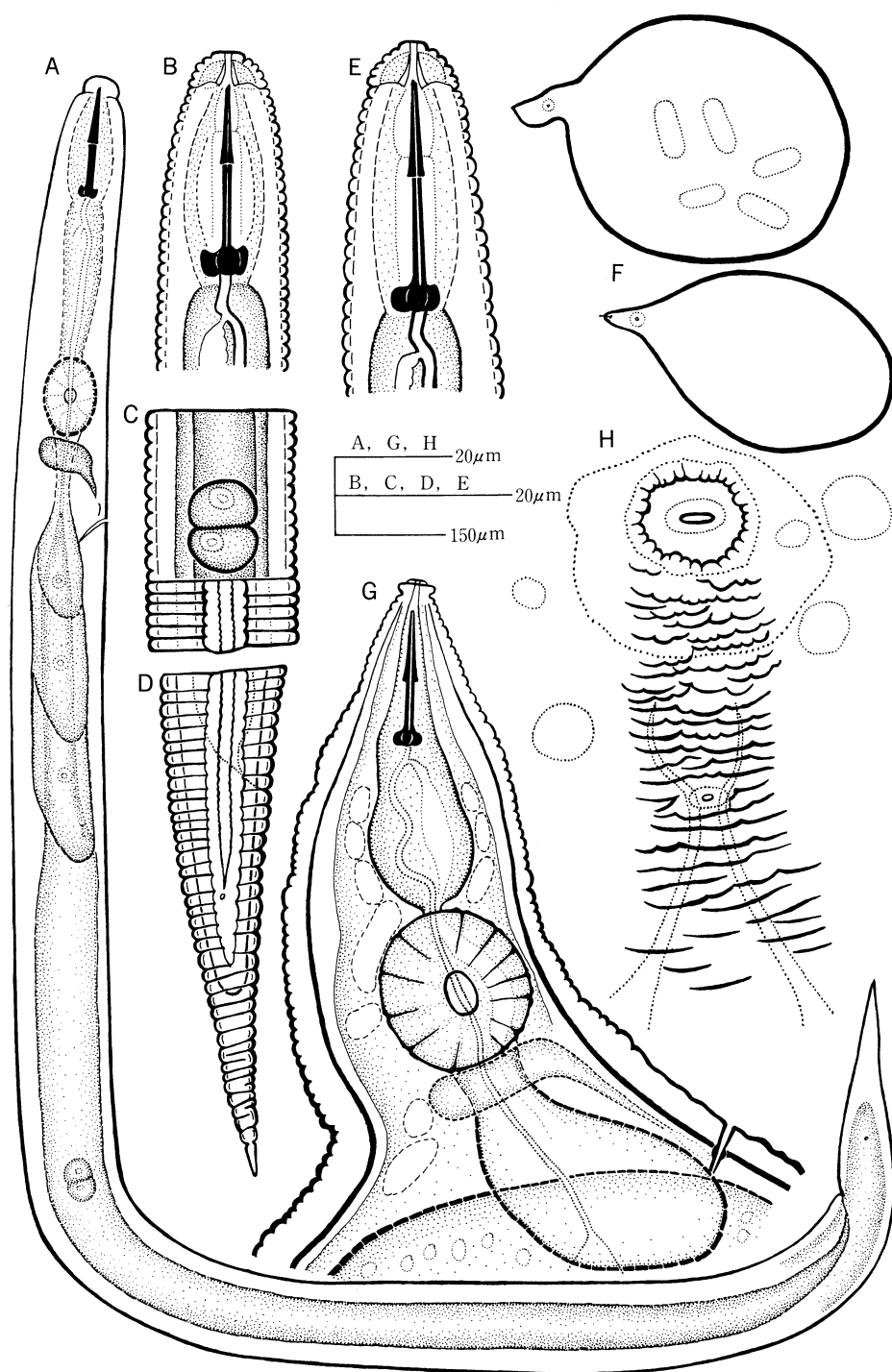


Fig. 1. *Globodera hypolysi* n. sp. A-D: second-stage larva, A: entire, B: head, C: gonadial primordium, D: tail, E: head of male, F-H: female, F: entire, G: head and neck, H: terminal region.

length=21-27(23.6) μ m, stylet=24-25(24.6) μ m, hyaline tail length/stylet length=0.8-1.0(0.95), o.d.e.=4-7(5.5) μ m, o=16-29.2(22.6), head width=9-10(9.8) μ m, head height=4-5(4.1) μ m, anterior end to gonadal primordium=250-290(270) μ m, g(=distance of gonadal primordium from anterior end \times 100/total body length)=55.3-62.3(57.3).

Body slightly curved ventrally when killed by moderate heating. Offset head hemispherical, with 5-6 annules. Lateral field about quarter body width with four incisures, starting at middle of stylet level and ending mid-way along the tail behind anus. Cephalic framework heavily sclerotized. Stylet well-developed with anteriorly concaved knobs. Anterior and posterior cephalids at second to third and 6th to 9th body annules, respectively. Valvated median bulb prominent, ellipsoidal, with its center 65-72(68.5) μ m from anterior end. Hemizonid two annules long, situated one annule (n=38) anterior to excretory pore. Hemizonion situated 7 to 11 annules, posterior to excretory pore. Gonadal primordium consisting of four cells, at about 60% of body length from anterior end. Tail tapering to small terminus sharply pointed. Phasmid minute, situated 7-12 annules or 18-22 (19) μ m behind anus.

Eggs. n=100, length=85-120(100.9) μ m, width=38-50(42.6) μ m, L/W ratio=1.7-3.1(2.4), no. egg per cyst (n=10)=63-187(138). Egg shell hyaline, without visible markings.

Type specimens

Holotype (female): Collected from greenhouse culture at Kaizu-cho, Isahaya, Nagasaki in October, 1980. Slide no. 80/11/12, deposited in Nagasaki Agricultural and Forestry Experiment Station. Allotype (male) and paratypes (males, females, cysts, larvae and eggs) on slide nos. 80/11/13-30, in the same collection.

Type host: mugwort (*Artemisia princeps* PAMP.)

Type locality: Azuma-cho, Shimabara, Nagasaki Pref., Japan.

DISCUSSION

Differential diagnosis of *Globodera hypolysi* n. sp. from other species of this genus is as follows. *G. hypolysi* n. sp. differs from *G. rostochiensis* (WOLLENWEBER, 1923) by the longer stylet of the second stage larvae (24.6 vs. 21.8 μ m), the profile of the stylet knobs in larvae (anteriorly concaved vs. backward incurvation) and smaller Granek's ratio of cysts (2.1 vs. 3.6)¹¹⁾. *G. hypolysi* n. sp. can be differentiated from *G. pallida* (STONE, 1973) by a shorter vulval slit (5.1 vs. 11.5 μ m) and a shorter stylet in female (24.4 vs. 27.4 μ m), and a greater distance from the stylet base to the dorsal gland orifice in larvae (5.5 vs. 2.7 μ m)^{10,12)}. *G. hypolysi* n. sp. also differs from the above two species in the host plant, i.e., *G. hypolysi* n. sp. does not reproduce on potato. Compared with three species of *Globodera*, *G. tabacum* (LOWNSEBRY et LOWNSEBRY, 1954), *G. solanacearum* (MILLER et GRAY, 1972) and *G. virginiae* (MILLER et GRAY, 1968), which can reproduce on tobacco^{5,6,7)}, *G. hypolysi* n. sp. differs in the following characters. The cysts of *G. tabacum* have a longer fenestra (29 vs. 21 μ m), the females have three annules in the lip region while only two on *G. hypolysi* n. sp., and rounded larval stylet knobs. *G. hypolysi* n. sp. differs from *G. solanacearum* and *G. virginiae* in that the latter two have a maze-like pattern of the ridges on the cyst in the anal-vulval region and a forward incurvation of the female stylet knobs. *G. hypolysi* n. sp. does not reproduce on tobacco⁹⁾.

G. achilleae (GOLDEN et KLINDIĆ, 1973) and *G. artemisiae* (EROSHENKO et KASACHENKO, 1972) parasitize species of Compositae^{2,3)}. *G. hypolysi* n. sp. resembles them with regard to the host plant but morphologically differs as follows: *G. artemisiae* differs from *G. hypolysi* n. sp. by the shorter distance from the anus to the fenestra in the cyst (26 vs. 44 μ m) and the female (32 vs. 48 μ m), the smaller length of the larvae (413 vs. 461 μ m), and a backward incurvation of the larval stylet knobs³⁾. *G. achilleae* differs from *G. hypolysi* n. sp. by the shorter distance from the anus to the fenestra in the cyst (27 μ m) and the female (29 μ m), the larger length of the larvae (492 μ m), and the rounded larval stylet knobs²⁾.

The remaining species of *Globodera* are *G. leptonepia* (COBB et TAYLOR, 1953) and *G. mali*

(KIRJANOVA et BORISENKO, 1975)^{1,4)}. The available information of these species is insufficient, but *G. leptonepia* differs from *G. hypolysi* n. sp. in the larva sevenfold larger than the egg within the egg, while fourfold on *G. hypolysi*, the shorter stylet of the second stage larvae (18 μ m), the elongated larvae measuring 567 μ m, and longer distance from the dorsal gland orifice to the stylet base in the larvae (about 12 vs. 5.5 μ m)¹⁾. *G. mali* also differs from *G. hypolysi* n. sp. in the cysts with a smaller value (0.7) of Granek's ratio⁴⁾.

G. hypolysi n. sp., with the "bullae-like structure" located around the fenestra of the cyst as well as with the anal area of the cyst and the female encircled by cuticular rings, shows distinctive characteristics compared to the other species of *Globodera* listed above⁸⁾. *G. hypolysi* n. sp. resembles *G. millefolii* (KIRJANOVA et KRALL, 1965) but differs in that the latter has a curved vulval slit about 14 μ m long⁸⁾, while that of the former is straight and 5.1 μ m long, and that the excretory pore is located midway along the female neck in *G. millefolii*⁴⁾ and towards the neck base in *G. hypolysi* n. sp.

Additional specimens of *G. hypolysi* n. sp. have been detected from the soil at Kazusa and Minami-Kushiyama, Nagasaki Prefecture.

The specific name of *G. hypolysi* is derived from the Greek word *ἵπολυσος*, mugwort.

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和 文 摘 要

日本産ヨモギのシストセンチュウ新種 *Globodera hypolysi*

小川義雄・大島康臣・一戸 稔

小川ら(1976)が長崎県島原半島で検出し、ジャガイモシストセンチュウと異なるとした *Globodera* 属線虫を、1979年、同県吾妻町でも検出し、接種試験によりヨモギでの増殖を確認し、またヨモギ寄生種 *G. artemisiae* を含む *Globodera* 属線虫と比較検討して形態的差異を認めたので、ヨモギシストセンチュウ *Globodera hypolysi* として記載した。雌成虫体長415 μ m(首を除く)、体幅318 μ m, L/W=1.3, 首長97 μ m, 口針長24.4 μ m, 節球は下向き、排泄口一頭端130 μ mで首基部に位置、陰門長16.5 μ m, 同幅14.4 μ m, 陰門隙長5 μ m、肛門一窓47.5 μ m。シストは体長475 μ m, 体幅448 μ m, L/W=1.2, 首長97 μ m, 窓長21 μ m, 窓幅19 μ m, 肛門一窓44 μ m, Granek's ratio=2.1, 窓周辺に珠胞様物が密。雄体長983 μ m, 体幅23 μ m, 口針長27.4 μ m, 節球は横向き、背部食道腺口一節球基部3.6 μ m, 精巢長464 μ m, 交接刺長29.2 μ m, 導帯長7.2 μ m, 側線4。第2期幼虫体長460 μ m, 尾長47 μ m, c=9.8, c'=3.9, 尾端透明部長23.5 μ m, 口針長24.5 μ m, 節球アンカー状、背部食道腺口一節球基部5.5 μ m, 頭部体環5~6, 4側線。卵長100 μ m, 卵幅43 μ m, L/W=2.4。

本種はヨモギまたはキク科を共通の寄主とする近似種 *G. artemisiae* または *G. achilleae* とは、シストおよび雌成虫の肛門一窓の距離、および第2期幼虫の体長と口針節球の形で区別される。